The Length of Uncomplicated Human Gestation

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By retrospective exclusion of gestations with known obstetric complications, maternal diseases, or unreliable menstrual histories, we found that uncomplicated, spontaneous-labor pregnancy in private-care white mothers is longer than Naegele's rule predicts. For primiparas, the median duration of gestation from assumed ovulation to delivery was 274 days, significantly longer than the predicted 266 days (P = .0003). For multiparas, the median duration of pregnancy was 269 days, also significantly longer than the prediction (P = .019). Moreover, the median length of pregnancy in primiparas proved to be significantly longer than that for multiparas (P = .0032). Thus, this study suggests that when estimating a due date for private-care white patients, one should count back 3 months from the first day of the last menses, then add 15 days for primiparas or 10 days for multiparas, instead of using the common algorithm for Naegele's rule. ***(Obstet Gynecol 75:929, 1990)***

Franz Carl Naegele (1778–1851), director of the Heidelberg Lying-in Hospital,[1] based his famous rule on the common belief that human gestation was ten menstrual cycles in duration,[2] and not on empirical data. Nevertheless, we continue to estimate that the length of gestation is 280 days from the first day of the last menstrual period (LMP) or 266 days from ovulation to delivery, assuming that the woman cycles every 28 days and ovulates on the 14th day.[3] However, based on experience, many clinicians believe that uncomplicated pregnancy in private-care white mothers may last longer. Indeed, Gibson[4] noted that the Irish calculate the estimated date of confinement (EDC) from the last rather than the first day of menses, thereby extending the due date by the number of days of the menstrual period. In the 277 women studied by Doering,[5] the mean interval between ovulation and delivery was 267.4 days, or 1.4 days longer than Naegele's rule predicts. Others have also shown that the length of gestation is longer than 266 days.[3,6,7] Although Evans et al[8] reported that more primiparas than multiparas have prolonged pregnancies, it has not been shown previously that dates of confinement for private-care white primiparas and multiparas are both 1) longer than the rule predicts, and 2) different from each other.

Because almost all previous studies of the length of human gestation included complicated and uncomplicated pregnancies together,[9–11] the observed delivery dates reflected the outcomes of both normal and abnormal pregnancies. However, the EDC should predict the length of a normal gestation ending in spontaneous labor, not one shortened by obstetric complications or maternal disease. Indeed, preterm delivery is a well-known outcome of pregnancies complicated by systemic disease in the mother, hydramnios, cervical incompetence, uterine anomalies, abruptio placentae, and placenta previa[12]; and toxemia, multiple births, and fetal anomalies.[13]

Furthermore, we assumed that a reliable menstrual history accurately predicts gestational age. Rossavik and Fishburne[14] recently confirmed this assumption in a study of in vitro fertilization pregnancies. Using the best polynomial equation of ultrasound dating (based on two ultrasound examinations at least 6 weeks apart, obtained before the third trimester) still resulted in 80% more error than the standard, ie, gestational length in women with regular menstrual cycles, known LMP, and a confirmatory pelvic examination from an experienced obstetrician.

Materials and Methods

We evaluated retrospectively all pregnancies delivered between April 1, 1983 and March 31, 1984 in a metropolitan-Boston private practice. Inpatient records were

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Table 1. Menstrual History Requirements for Study Inclusion

1) The last menses were normal and the exact dates were known.
2) The second-to-last menses were normal and the dates were known.
3) The patient's typical menstrual cycle was 28–32 days in length.
4) If oral contraceptives had been used, at least one spontaneous period preceded the menses dating the pregnancy.

reviewed at St. Margaret's Hospital for Women, Boston, and the Quincy City Hospital, Quincy, Massachusetts. When the hospital chart contained any evidence of an obstetric complication (eg, premature rupture of the membranes or maternal disease such as bone cancer), the pregnancy was excluded from the study. However, if the hospital record contained no evidence of abnormality, then the office record was screened. When no complications were found during that review and the patient's menstrual history was reliable (Table 1), the pregnancy was included in the study. We assumed that the date of ovulation occurred on day 14 if the patient usually had 28-day cycles, on day 15 if she had 29-day cycles, etc.

Professional services were provided by three board-certified obstetricians, one of whom (RM) reviewed all charts. Menstrual histories were taken by a trained interviewer, then confirmed by one of the physicians during the first prenatal visit. To prevent the preterm labor associated with asymptomatic bacteriuria,[15] each patient received a urine screening at every prenatal visit. Urinary tract infections were treated and then followed up to ensure suppression of recurrent disease.

To test the hypotheses that the length of uncomplicated human gestation is longer than the rule predicts and that the length of primiparous pregnancy differs from that of multiparous, two parity cohorts were formed. Nonparametric methods, which do not assume a normal distribution of the data, were used for statistical analysis. The sign test[16] was used to distinguish differences between the 266-day duration of pregnancy predicted by Naegele's rule and that of each of the two groups. The Wilcoxon-Mann-Whitney rank sum test[16] was used to determine differences in the median lengths of gestation between primiparas and multiparas. Analyses were performed with Minitab Statistical Software (Minitab, Inc., State College, PA).

Results

Hospital charts were available for 339 deliveries. Review of those records led to the exclusion of 120 subjects from the study because of obstetric complications or maternal disease. An additional 105 pregnancies were excluded after review of the prenatal record, mostly because of irregular menses or uncertain menstrual dates. Tables 2 and 3 list the indications for excluding a pregnancy and specify the numbers in each of the categories. The final number of uncomplicated, primiparous pregnancies with reliable menstrual dates was 31; 83 multiparas had excellent dates and uncomplicated gestations. Most patients delivered later than the date predicted by Naegele's rule. In fact, 81% (25 of 31) of the primiparas and 61% (51 of 83) of the multiparas had gestations that exceeded the prediction. No primiparas and only two multiparas had preterm deliveries (by definition, gestational lengths of fewer than 245 days from ovulation to delivery). Figure 1 shows the lengths of gestation by 7-day intervals for both primiparas and multiparas.

For primiparas, the one-sample sign test[16] indicated that the sample median of 274 days was significantly

Table 2. Study Exclusions From Hospital Records

Elective repeat cesarean	26
Induction	14
Intervention for fetal distress	4
Chronic hypertension	6
Pregnancy-induced hypertension	11
Placental abruption (with or without hypertension)	4
Placenta previa	1
Premature rupture of membranes and/or chorioamnionitis	40
Polyhydramnios	3
History of incompetent cervix	7
Maternal history of thyroid cancer	1
Maternal bone cancer	1
Positive group B beta-hemolytic streptococcus culture (infant)	1
Positive group A beta-hemolytic streptococcus culture (mother)	1
Total	120

Table 3. Study Exclusions From Office Records

History of maternal seizure disorder	1
History of cervical conization	1
Premature cervical dilatation	4
Multiple gestation	3
Irregular menses or poor menstrual dates	75
Previous exposure to diethylstilbestrol in utero	10
Bicornuate uterus	2
Arthritis or positive antinuclear antibodies	2
Fetal anomalies	2
History of thyroid replacement	1
Colitis	1
Suspected intrauterine growth retardation	1
Cholestatic jaundice of pregnancy	1
Genital herpes during pregnancy	1
Total	105

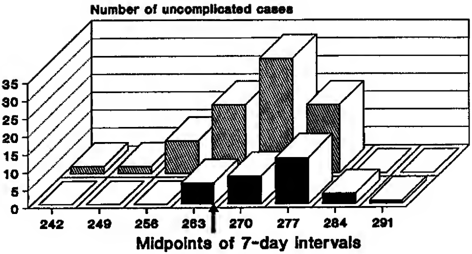

Figure 1. Frequency distributions of the lengths of gestation (ovulation to delivery) for primiparas ($N = 31$) (*solid bars*) and multiparas ($N = 83$) (*striped bars*). Arrow marks Naegele's estimated date of confinement.[1]

different ($P = .0003$) from 266 days. The 95% confidence interval for primiparas ranged from 269–276 days. For multiparas, the same nonparametric analysis likewise showed that the sample median of 269 days differed significantly ($P = .019$) from 266 days. The 95% confidence interval for multiparas ranged from 267–270 days. Comparing the median of the primiparous cohort with the median of the multiparous group, the Wilcoxon-Mann-Whitney test[16] demonstrated that the two values were significantly different from each other ($P = .0032$). The 95% confidence interval for the difference between the two medians was 2.0–8.0 days. Thus, the EDC for the primiparous mother is significantly later than that for the multiparous mother.

Discussion

We conclude that the duration of uncomplicated pregnancy for whites receiving private care is longer than Naegele's rule predicts. Moreover, parity appeared to be an important determinant of the due date. For primiparas, the median EDC was 8 days later than Naegele's rule specifies, whereas for multiparas, it was 3 days later. Thus, the private-care white primipara who menstruates every 28 days has a median length of gestation (from the first day of menses to delivery) of 41 and 1/7 weeks, not 40 weeks. For the private-care white multipara, the median length of gestation is 40 and 3/7 weeks.

Are these small, highly selected samples representative of other races and health care settings? Studies of other racial groups have shown that the length of gestation may actually be shorter than Naegele's rule predicts. In a prospective study of 110 Japanese women by Saito et al,[10] the mean interval between ovulation and delivery was 264.2 days. The 95% confidence interval ranged from 262.3–266.1 days. As in the current study, the authors excluded cases with certain prenatal or maternal complications. All labors were spontaneous, and the dates of ovulation were determined by basal body temperatures. In a study that compared the duration of pregnancy in blacks and whites of similar socioeconomic status, Henderson and Kay[17] found that black women had mean gestational lengths from LMP to delivery of 263.6 days. It is interesting that the mean duration of pregnancy in blacks was about 8.5 days shorter than that in whites. All patients received care at the same prenatal clinic, but there was no stratification by parity.

Despite the above findings, the true length of uncomplicated gestation in private-care white women may be even longer than our study predicts. The exclusion of elective repeat cesareans and induced labors may have artificially truncated the right-hand tail of the applicable frequency distribution. No multipara delivered later than the 281st day of gestation; no primiparous pregnancy exceeded 290 days' duration.

Future research, done prospectively on larger cohorts, should more precisely characterize the entire, nontruncated frequency distribution. In addition, certain mothers who were excluded from this study, such as those with pregnancies induced for various indications or those who underwent elective repeat cesarean, could be retained in estimating the length of uncomplicated gestation by using statistical methods recommended by Kaplan and Meier.[18] Larger studies also offer the advantage of stratifying on risk factors possibly associated with differing lengths of gestation, eg, race, maternal age, the many levels of parity, and history of smoking or alcohol consumption. Finally, incorporating basal body temperature and ultrasound in the study design could help to verify the assumed

date of ovulation, permitting the inclusion of women with irregular menstrual cycles.

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